

# International Network to Encourage the Use of Monitoring and Forecasting Dust Products

# inDust

*COST Action CA16202*

[www.cost-indust.eu](http://www.cost-indust.eu)

# Background

- Sand and Dust Storms (SDS) play a significant role in different aspects of weather, climate and atmospheric chemistry and represent a serious hazard for life, health, property, environment and economy.
- Understanding, managing and mitigating SDS risks and effects requires fundamental and cross-disciplinary knowledge.



*Tehran, Iran, June 2014*

# Dust Impacts

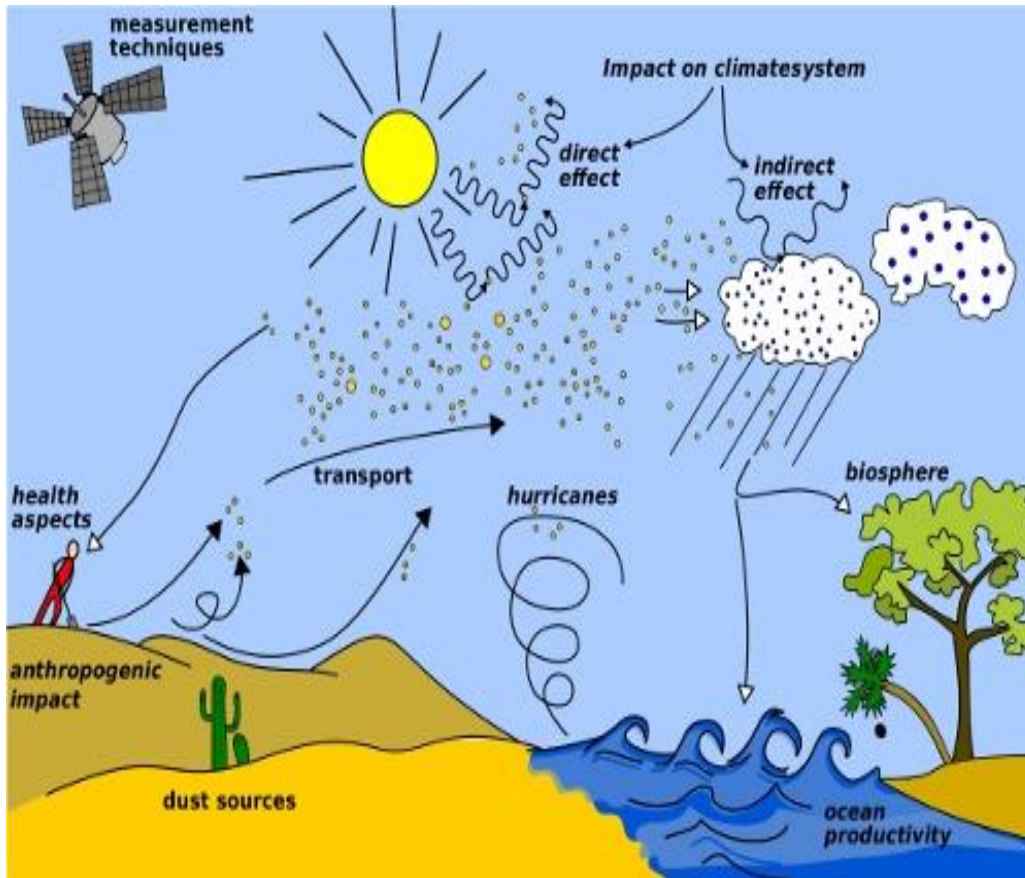


Image from WMO website  
(<http://www.wmo.int/pages/prog/arep/wwrp/new/hurricanes.html>)

## Ecosystems, meteorology and climate

- *Marine productivity*
- *Coral mortality*
- *Hurricanes formation*

## Air Quality and Human Health

- *Respiratory disease (asthma)*
- *Eye infections*
- *Meningitis in Africa*
- *Valley Fever in the Americas*

## Aviation and Ground Transportation

- *Low visibility (i.e. air disasters)*

## Agriculture and fishing

## Energy and industry

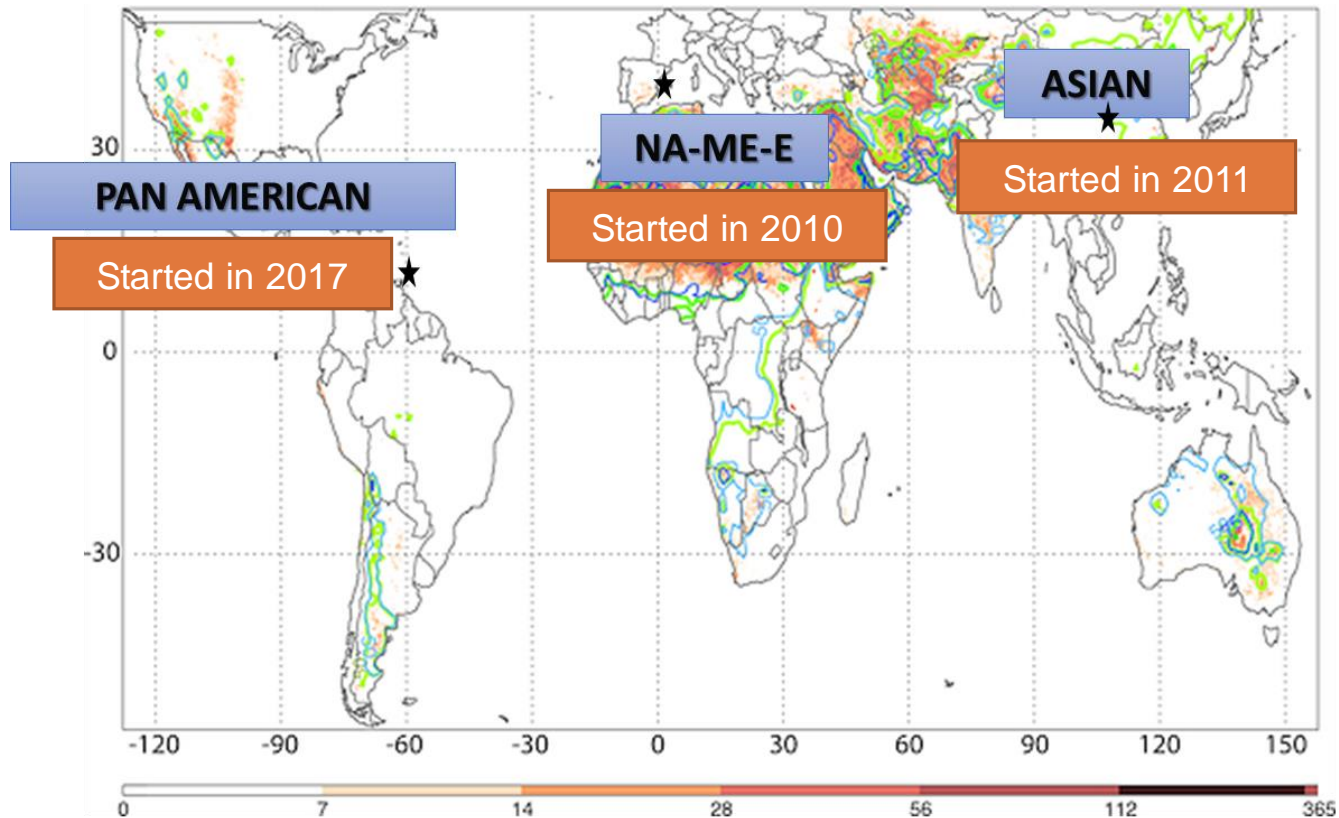
# WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)

- Objectives:

- Identify and improve **products to monitor and predict dust** by working with research and operational organizations, as well as with users.
- Facilitate **user access** to information
- Strengthen the **capacity of countries to use** the observations, analysis and predictions provided by the WMO SDS-WAS



# SDS-WAS and the Regional Nodes/Centers



Annual mean frequency distribution of M-DB2 (2003–2009) DOD > 0.2 (red), TOMS (1980–1991) aerosol index  $\geq 0.5$  (blue), and OMI (2004–2006) aerosol index  $\geq 0.5$  (green). The isocontours of TOMS and OMI have been removed over oceans for clarity.

Extracted from Ginoux et al. (2012, Rev. Geophys.)

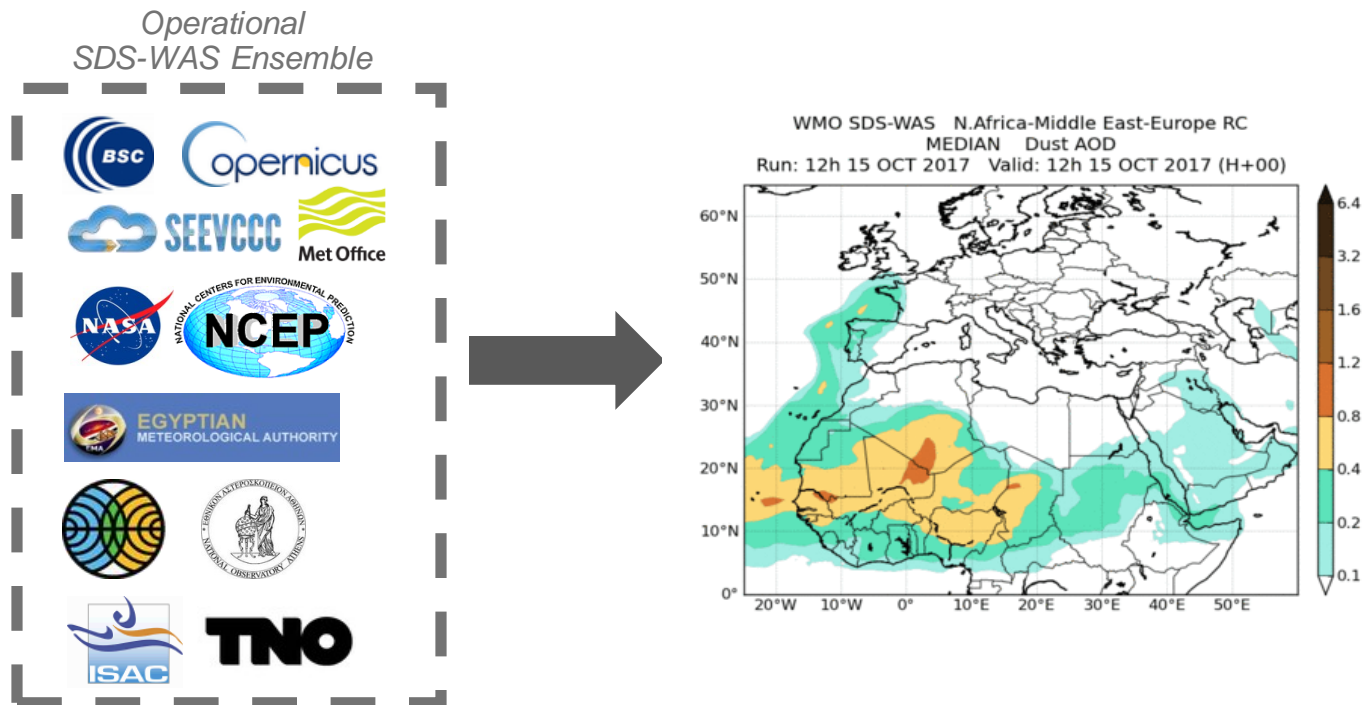


WORLD  
METEOROLOGICAL  
ORGANIZATION

# SDS-WAS and the NAMEEE Regional Center

## ■ Modelling

- Products: **concentration and AOD maps**, the SDS-WAS multi-model product.



12 Global – Regional models from ~ 100 to 10 km)



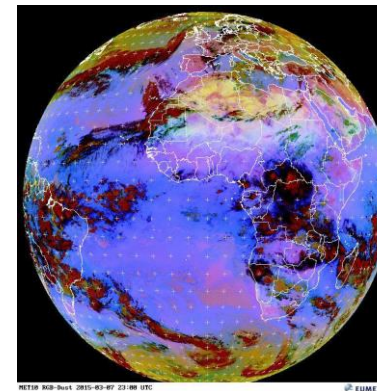
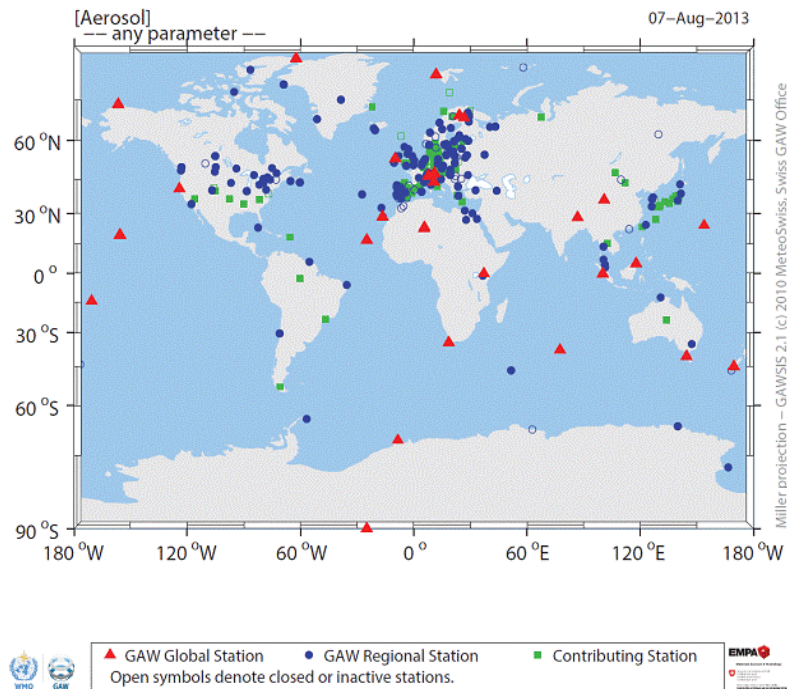
<http://sds-was.aemet.es/>



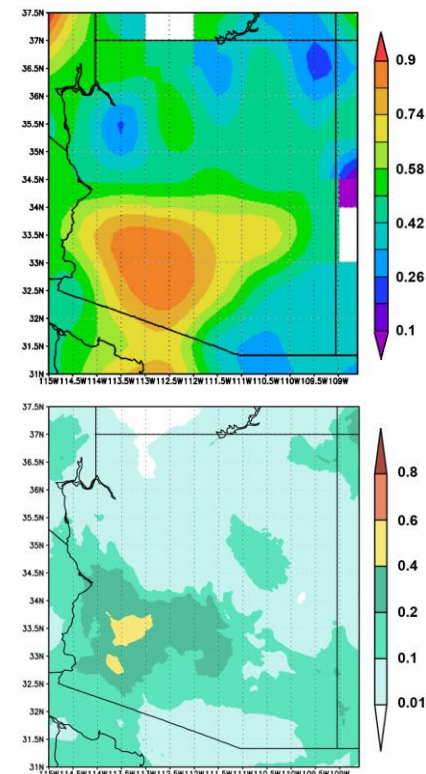
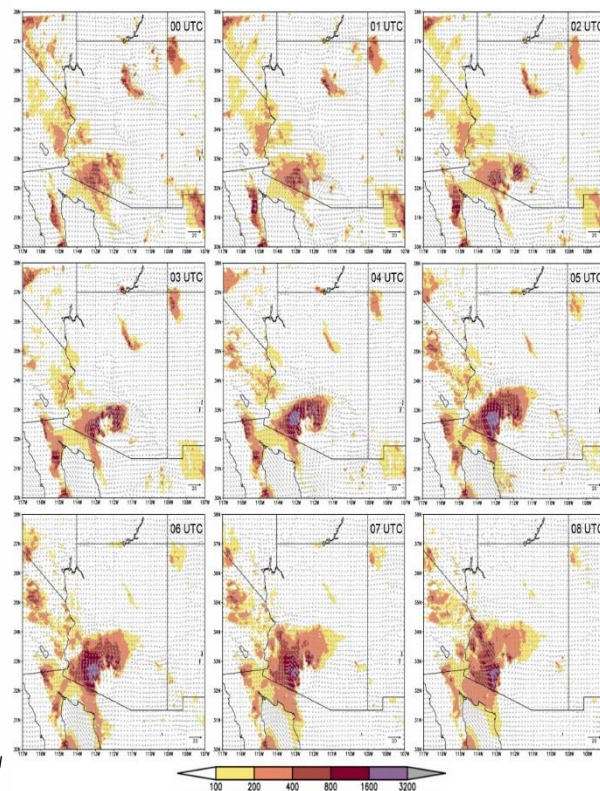
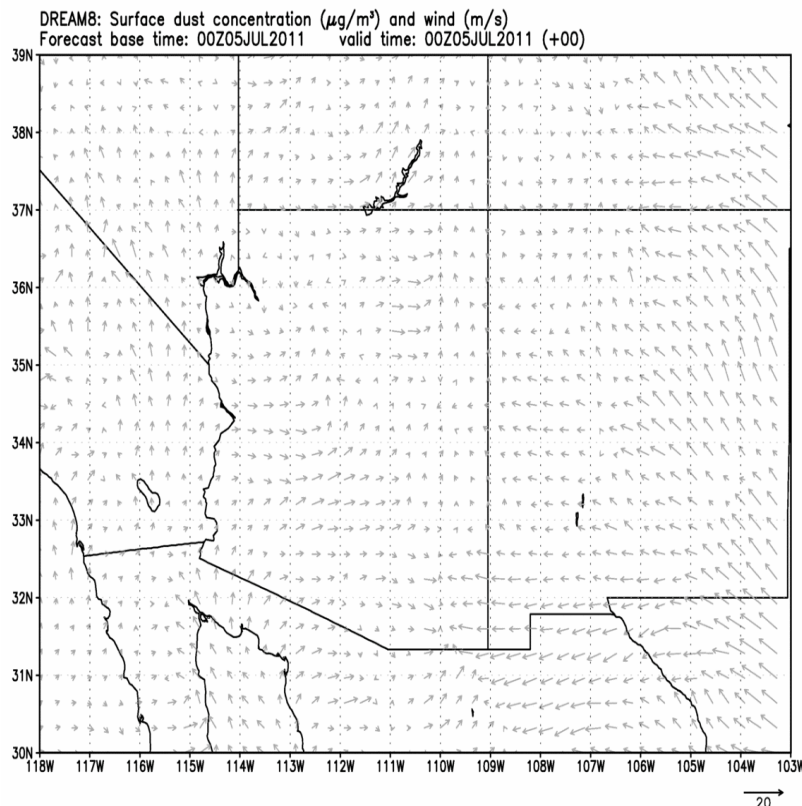
# SDS-WAS and the NAMEE Regional Center

## ■ Observations

- Better understanding and track of SDS
- Used for model evaluation and data assimilation
- Lack of dust observations, particularly in Africa



# NUMERICAL SIMULATION OF “AN AMERICAN HABOOB”



A. Vukovic, M. Vujadinovic, G. Pejanovic, J. Andric, M. J. Kumjian, V. Djurdjevic, M. Dacic, A. K. Prasad, H. M. El-Askary, B. C. Paris, S. Petkovic, W. Sprigg, and S. Nickovic, “Numerical Simulation of “An American Haboob””, Atmos. Chem. Phys. Discuss., 13, 26175-26215, 2013.



# SDS-WAS and the NAMEEE Regional Center

## ■ Capacity building

- Trainings focusing on the **weather** community and PhD Students



Accra  
Addis-Ababa  
Ankara  
Antalya  
Barcelona  
Cairo  
Casablanca  
Istanbul  
Madrid  
Muscat  
Niamey  
Ouagadougou  
Tehran  
Tbilisi

# SDS-WAS and the NAMEE Regional Center

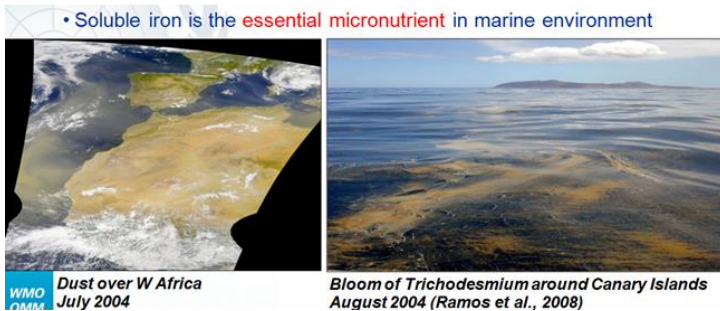
## Lessons learnt:

- Lack of coordination between measurement and modelling groups.
  - Measurement products lack harmonised quality controls, data formats and measurements schedules
    - This is more dramatic when you consider Northern African and the Middle East where we find the deserts
- Advertise about Sand and Dust Storms
  - Enhance the visibility of the dust impacts to the society at large and the most affected socio-economic sectors in particular
- Not “really” tailored user-oriented products
  - Few existing channels of communication between scientific research and user (socio-economic) communities.

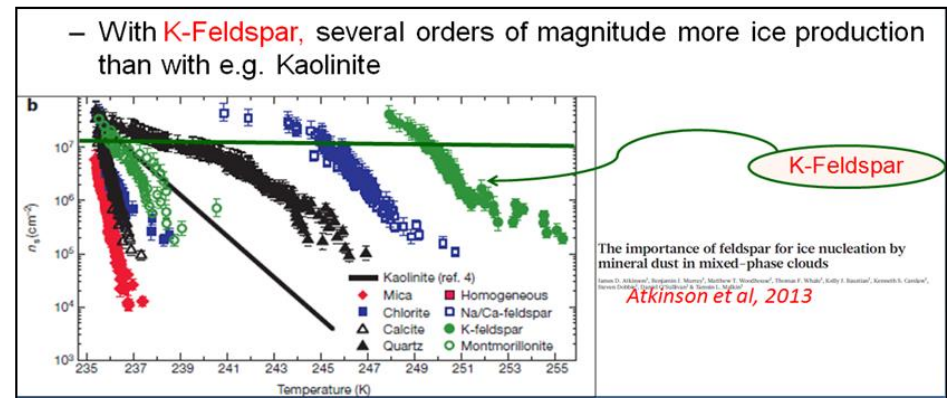
# iD Applications: examples

## ■ Mineral composition of dust: Impacts

- Fe and P embedded in dust → **ocean nutrients**
- **Cloud ice nucleation** sensitive to dust mineral composition
- **Radiation** absorption/reflection depends on dust colour → desert's composition
- Fe as an enhancement factor in **meningitis outbreaks** in the Sahel and in bacterial infections in general



Algae bloom due to dust/Fe



Different minerals -> different ice nucleation efficiency

# Dust Impacts on Red Sea Primary Productivity



Article

## Synergistic Use of Remote Sensing and Modeling to Assess an Anomously High Chlorophyll-*a* Event during Summer 2015 in the South Central Red Sea

Wenzhao Li<sup>1</sup>, Hesham El-Askary<sup>2,3,4,\*</sup>, K. P. ManiKandan<sup>5</sup>, Mohamed A. Qurban<sup>5,6</sup>, Michael J. Garay<sup>7</sup> and Olga V. Kalashnikova<sup>7</sup>

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<sup>4</sup> Department of Environmental Sciences, Faculty of Science, Alexandria University, Moharem Bek, Alexandria 21522, Egypt

<sup>5</sup> Center for Environment and Water, The Research Institute, King Fahd University of Petroleum and Minerals (KFUPM), Dhahran 31261, Saudi Arabia; manikand@kfupm.edu.sa (K.P.M.); mqurban@kfupm.edu.sa (M.A.Q.)

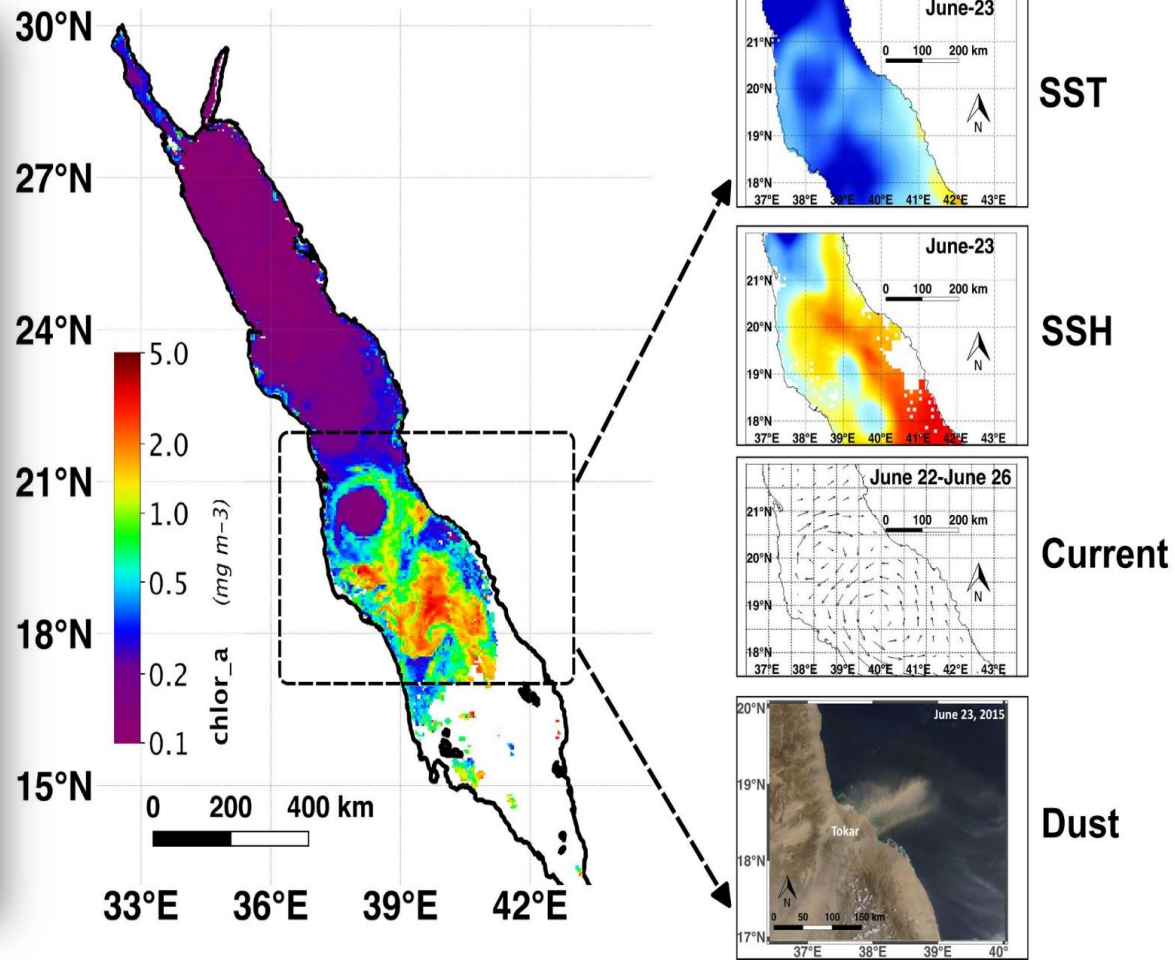
<sup>6</sup> Geosciences Department, the college of Petroleum Engineering & Geosciences, King Fahd University of Petroleum and Minerals (KFUPM), Dhahran 31261, Saudi Arabia

<sup>7</sup> Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA; michael.j.garay@jpl.nasa.gov (M.J.G.); olga.kalashnikova@jpl.nasa.gov (O.V.K.)

\* Correspondence: elaskary@chapman.edu; Tel: +1-714-289-2053

Received: 19 May 2017; Accepted: 27 July 2017; Published: 29 July 2017

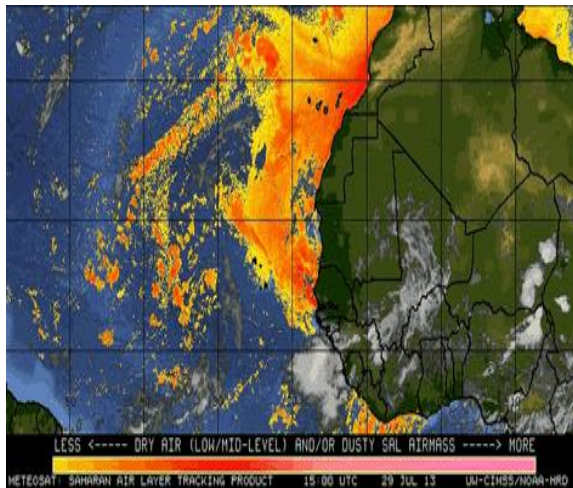
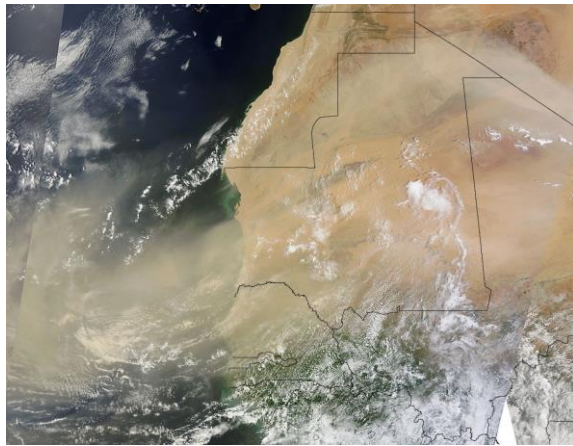
**Abstract:** An anomalously high chlorophyll-*a* (Chl-*a*) event ( $>2 \text{ mg/m}^3$ ) during June 2015 in the South Central Red Sea ( $17.5^\circ$  to  $22^\circ\text{N}$ ,  $37^\circ$  to  $42^\circ\text{E}$ ) was observed using Moderate Resolution Imaging Spectroradiometer (MODIS) data from the Terra and Aqua satellite platforms. This differs from the low Chl-*a* values ( $<0.5 \text{ mg/m}^3$ ) usually encountered over the same region during summertime. To assess this anomaly and possible causes, we used a wide range of oceanographical and meteorological datasets, including Chl-*a* concentrations, sea surface temperature (SST), sea surface height (SSH), mixed layer depth (MLD), ocean current velocity and aerosol optical depth (AOD)



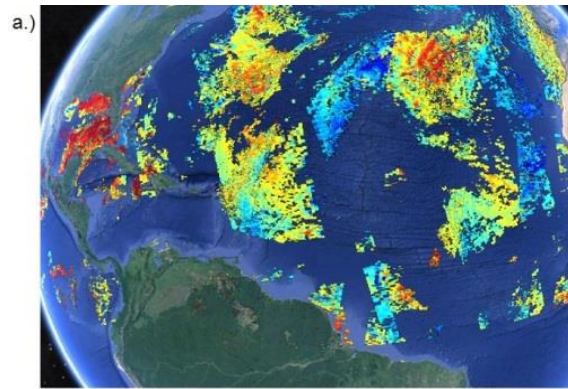


# iD Applications: examples

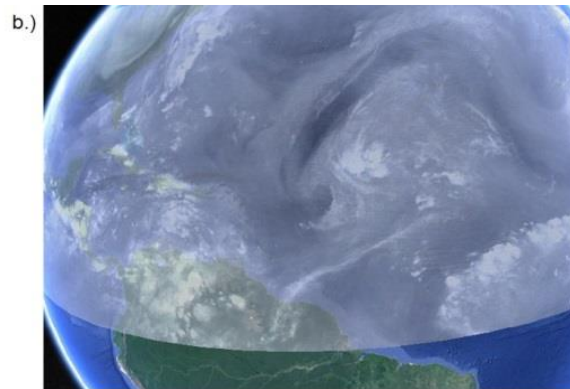
## ■ Dust Impact on Hurricanes formation



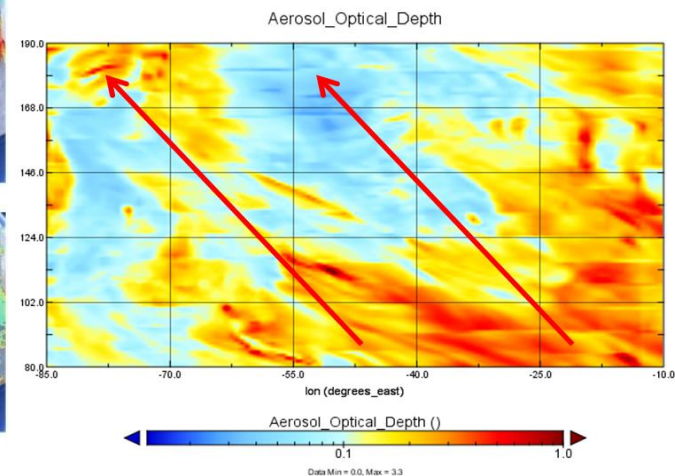
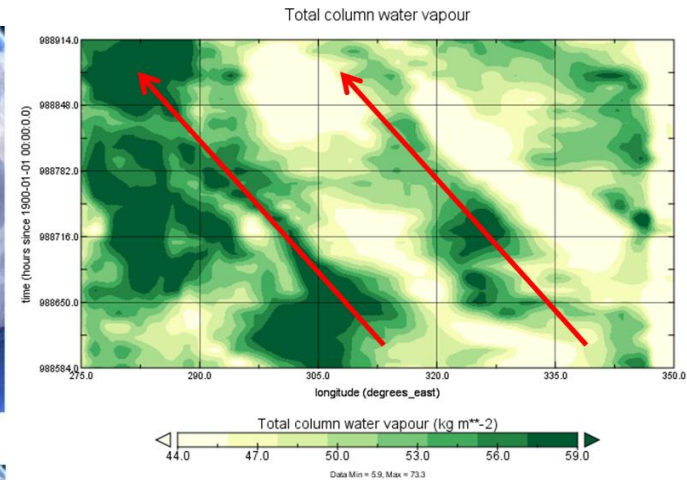
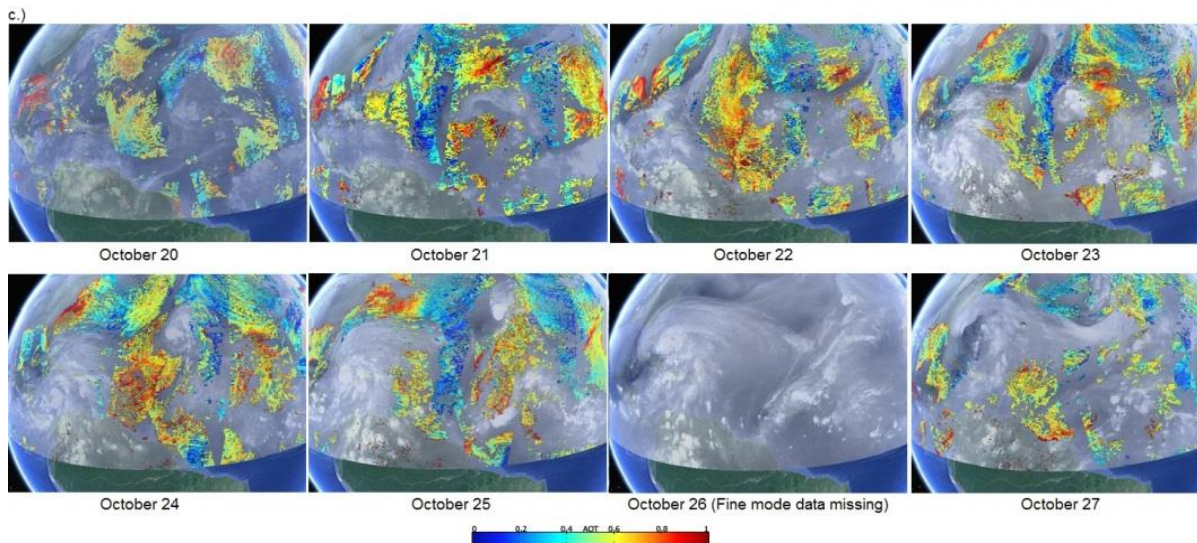
# Link between Hurricanes formation and Dust storms



October 20th, Fine Mode AOT, AQUA and TERRA



October 20th, Water Vapor





# iD Applications: examples

## ■ Dust Impact on Hurricanes formation



## Characterizing the Impact of Aerosols on Pre-Hurricane Sandy

Andrew T. Fontenot, Hesham M. El-Askary, *Member, IEEE*, Michael J. Garay, Olga V. Kalashnikova, and J. R. Campbell

Fontenot A., El-Askary H., Garay M., Kalashnikova O., Campbell J., Characterizing the Impact of Aerosols on Pre-Hurricane Sandy\JSTARS-2017-00521.R2, In press 2018

*Abstract*—This study focuses on the role that African dust over the Atlantic had on the persistence of the tropical system that eventually became Hurricane Sandy in October 2012. On October 8 a Saharan dust event in the Mauritania region of West Africa transported significant amounts of mineral dust into the troposphere and along the path of an easterly wave created by a break in the Intertropical Convergence Zone (ITCZ). The Terra/Aqua-MODIS satellite observations clearly define the

perturbations to tropical cyclone intensity [3]. In the tropical Atlantic basin, this is a unique consideration given the frequency and intensity of Saharan dust plumes propagating westward off the West African coastline [4]. In this paper, further such inquiry is described by characterizing the aerosol environment influencing the pre-Hurricane Sandy tropical wave in 2012. Specifically, we investigate the impact that a major dust event, originating over the Mauritania region, may

# Applications: examples

- Air Quality and Human Health
  - *Respiratory disease*



GLOBAL CARDIOLOGY  
SCIENCE & PRACTICE

OPEN ACCESS

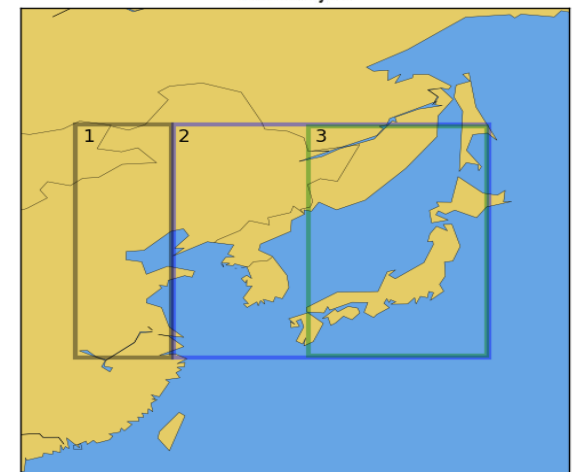
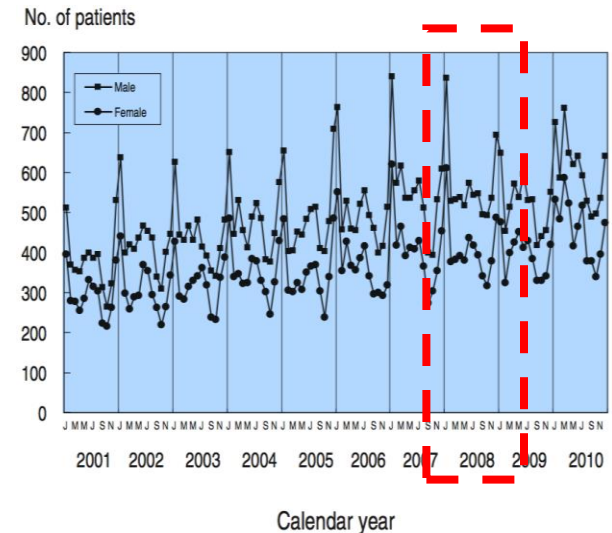
Research article

## Remote sensing observation of annual dust cycles and possible causality of Kawasaki disease outbreaks in Japan

Hesham El-Askary<sup>1,2,3\*</sup>, Nick LaHaye<sup>1,4</sup>, Erik Linstead<sup>1</sup>, William A. Sprigg<sup>5</sup>, Magdi Yacoub<sup>6</sup>

### ABSTRACT

Kawasaki disease (KD) is a rare vascular disease that, if left untreated, can result in irreparable



<sup>1</sup>Schmid College of Science and Technology, Chapman University, Orange, CA, USA

<sup>2</sup>Center of Excellence in Earth Systems Modeling & Observations, Chapman

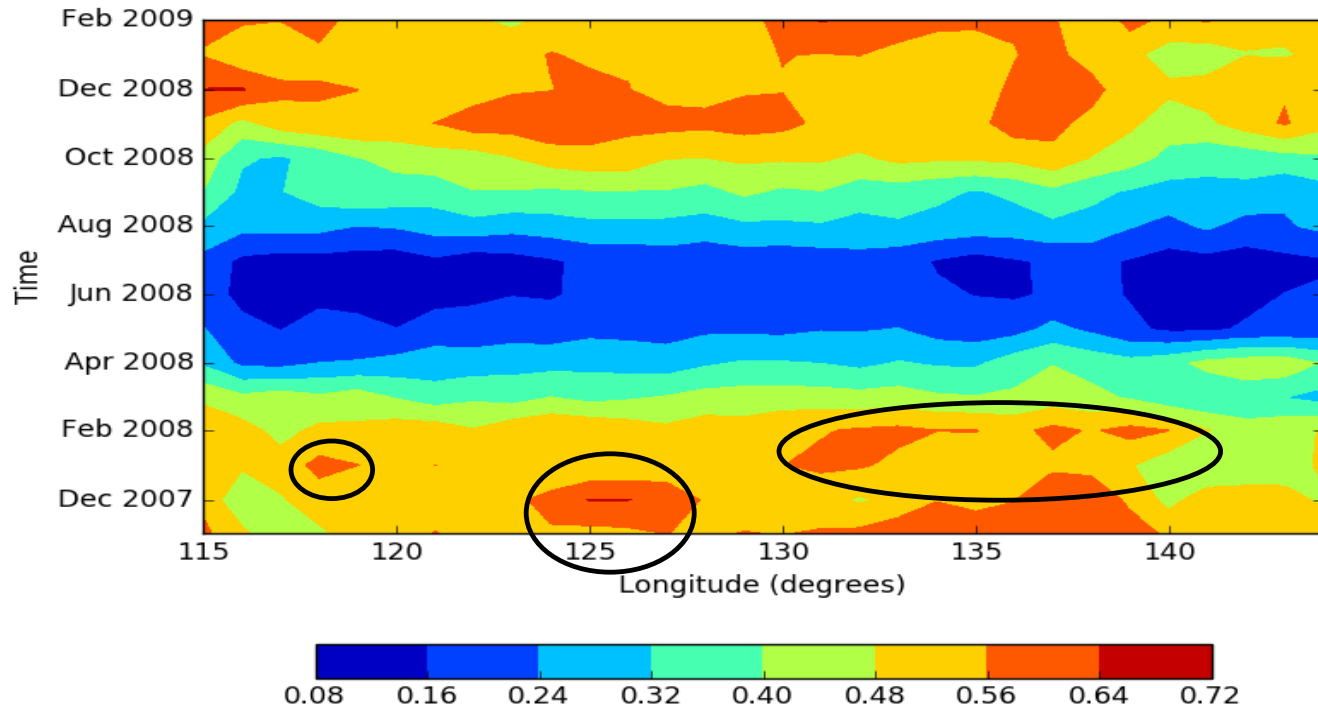
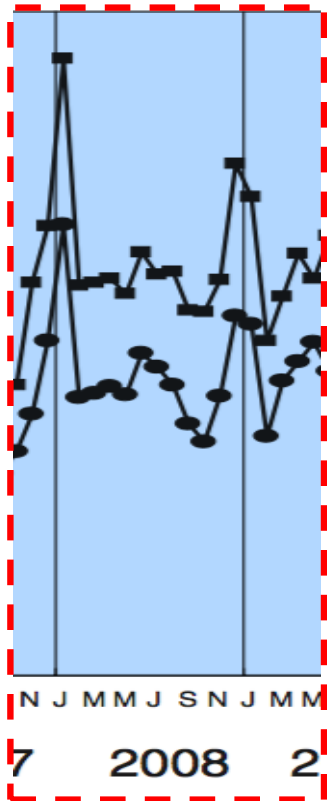


# iD Applications: examples

## ■ Air Quality and Human Health

- *Respiratory disease*

This is very much in agreement with the aforementioned papers that discuss the seasonality of KD in this region.



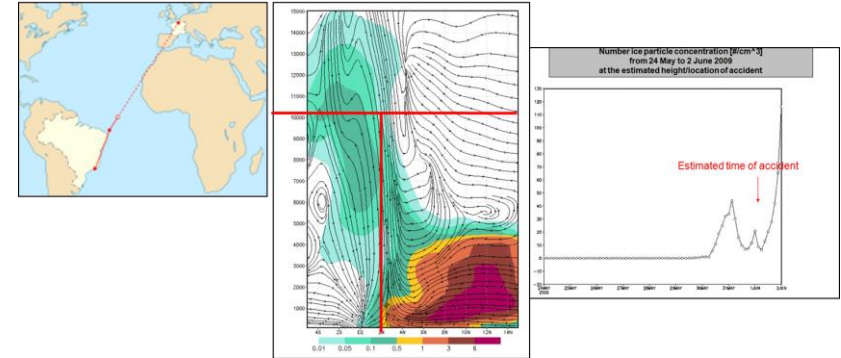
Fine Mode Fraction over land and ocean over the entire region of study

# iD Applications: examples

## ■ Dust and aviation

- Visibility
- Ice nucleation
- Dust melting in turbines
- Turbine abrasion

## AirFrance 2009 accident (icing due to dust?)



Phoenix, USA

## EGYPTAIR - ACCIDENT CAUSED BY DUST STORM

<http://edition.cnn.com/2002/WORLD/africa/05/07/tunis.crash/index.html>

**TUNIS, Tunisia (CNN) 7 May, 2002, 17:44 GMT --** An EgyptAir jet crashed on a hillside outside Tunisia's capital Tuesday as the pilot attempted to make an emergency landing, killing at least 18 people, a government official said...

...Weather was foggy and rainy at the time, with sandstorms blowing in from the Sahara Desert. ...

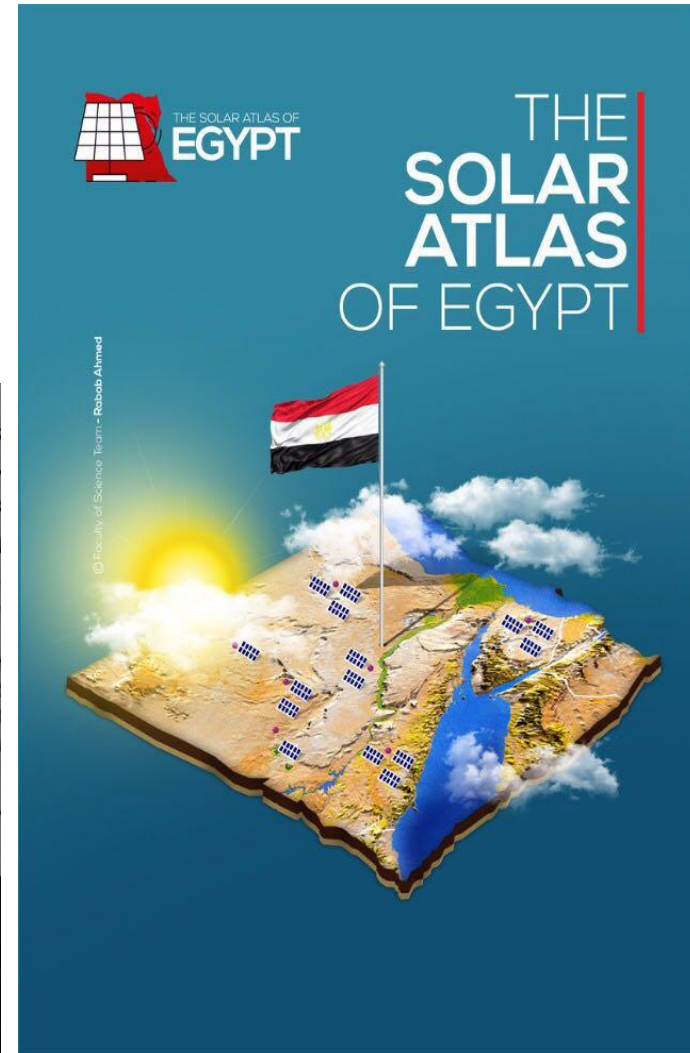
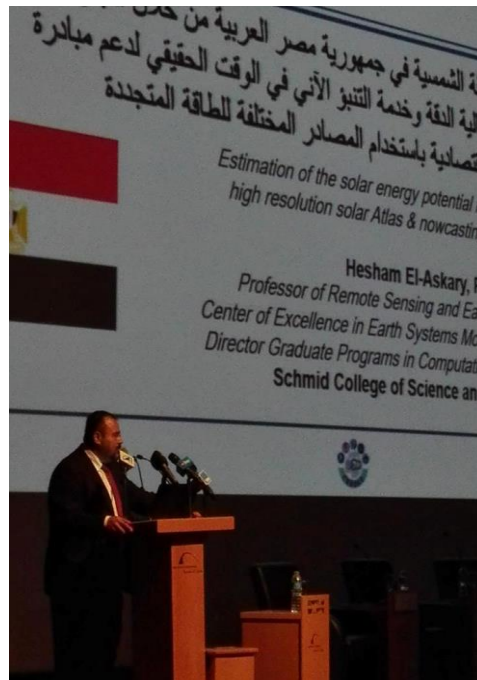


# Applications: examples

- Dust and solar power plants
  - Solar irradiance
  - Clouds formation – inducing a reduction of the incoming solar irradiance
  - Soiling → water managements







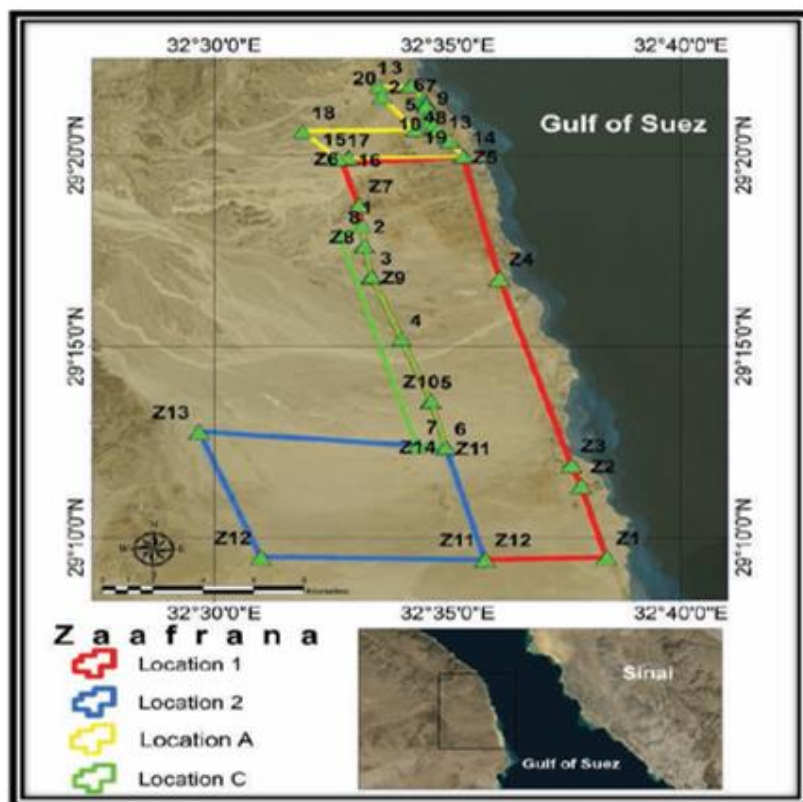




# NREA lands solar power and energy potential for PV and CSP installations



MAP OF THE FOUR LOCATIONS OF ZAAFRANA AREA



Monthly mean solar energy in kWh/m<sup>2</sup> for PV systems for the 5 lands of the Suez Governorate (Zaafrana Zone).

SOLAR ENERGY PV (KWH/M2)				
LOCATION	1	2	3	4
JAN	125	116	118	123
FEB	139	131	131	137
MAR	197	188	190	196
APR	220	207	211	216
MAY	249	237	243	245
JUN	258	248	257	255
JUL	261	250	258	256
AUG	244	234	242	242
SEP	208	200	204	207
OCT	174	167	170	173
NOV	134	128	129	133
DEC	118	113	113	117
TOTAL	2326	2216	2262	2298

Monthly mean solar energy in kWh/m<sup>2</sup> for CSP systems for the 5 lands of Suez Governorate (Zaafrana Zone).

SOLAR ENERGY CSP (KWH/M2)				
LOCATION	1	2	3	4
JAN	181	163	159	177
FEB	174	160	151	170
MAR	235	221	213	230
APR	228	210	208	218
MAY	253	237	239	242
JUN	285	272	279	275
JUL	289	273	279	275
AUG	274	259	264	264
SEP	251	241	237	247
OCT	224	214	209	221
NOV	195	187	176	192
DEC	181	174	165	178
TOTAL	2767	2607	2577	2685

# International Network to Encourage the Use of Monitoring and Forecasting Dust Products

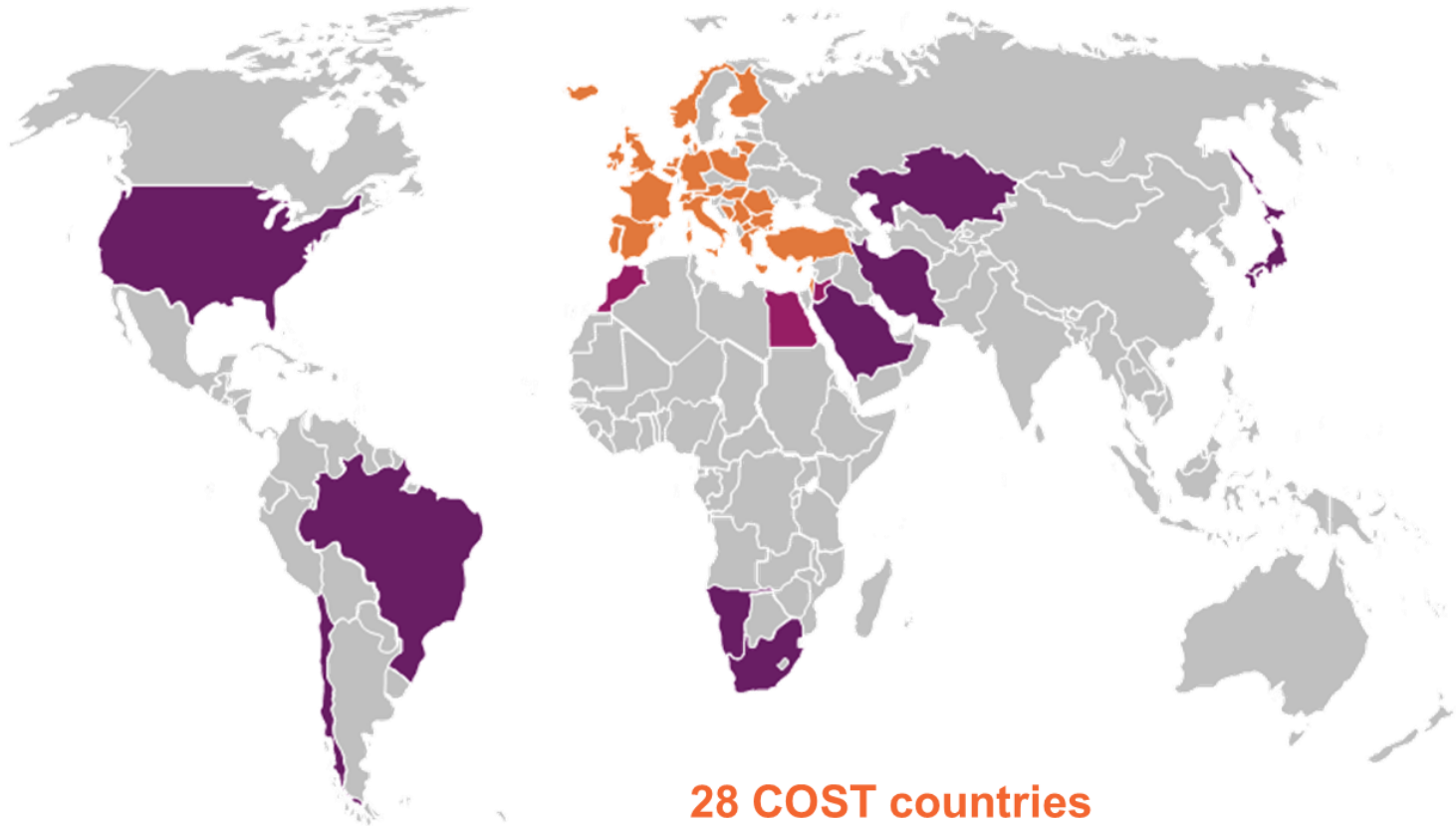
# inDust

*COST Action CA16202*

[www.cost-indust.eu](http://www.cost-indust.eu)

## Our goals

- To **establish a network** involving research institutions, service providers and potential end users of information on airborne dust.
  - Promote initiatives that can expand beyond the Action
- To **coordinate** and **harmonise** the process of transferring dust observations and predictions to users (including researchers and stakeholders).
- To **assist** the diverse socio-economic sectors affected by the presence of high concentrations of airborne mineral dust.



**28 COST countries**

**3 NNCs**

**9 IPCs**

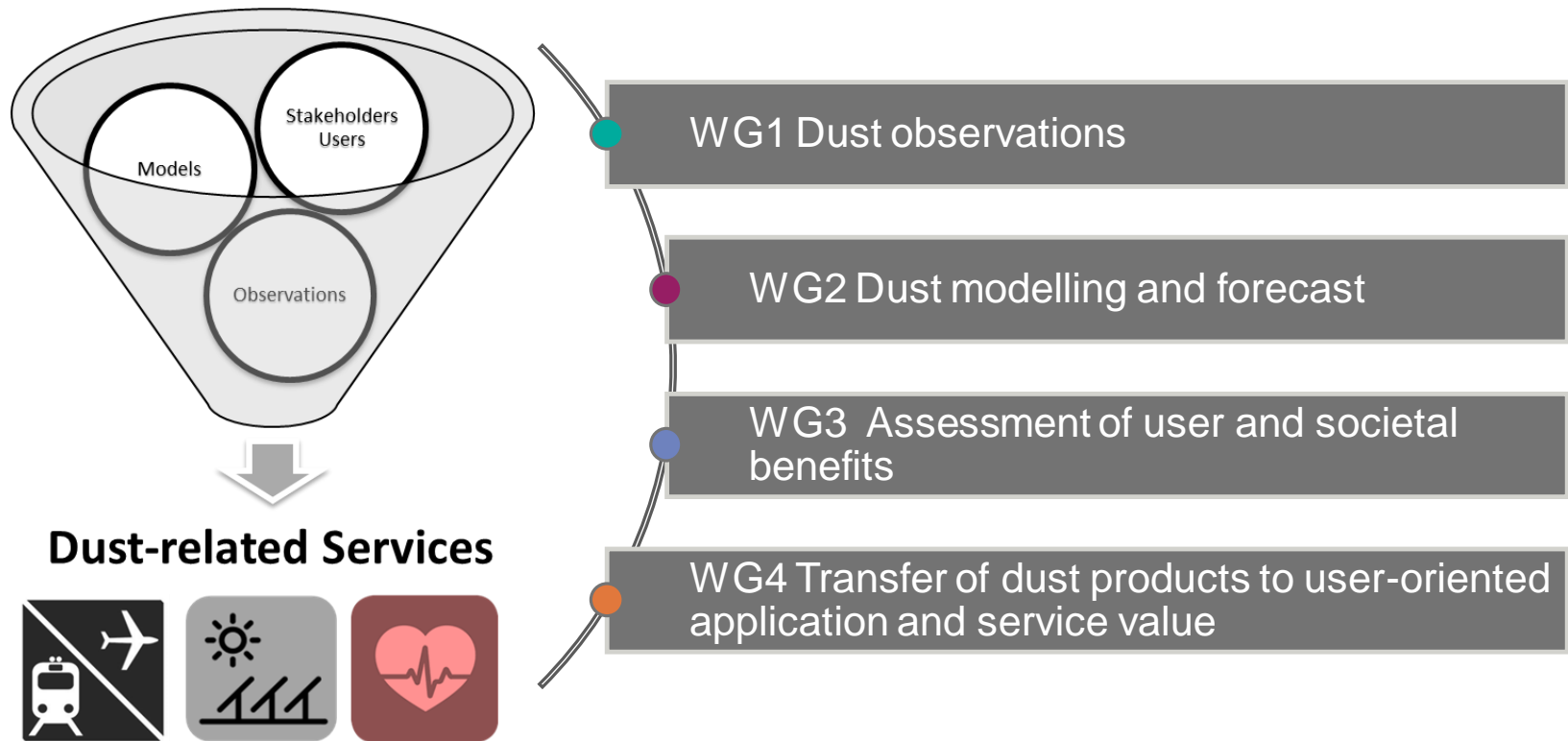
**1 International Body (WMO)**



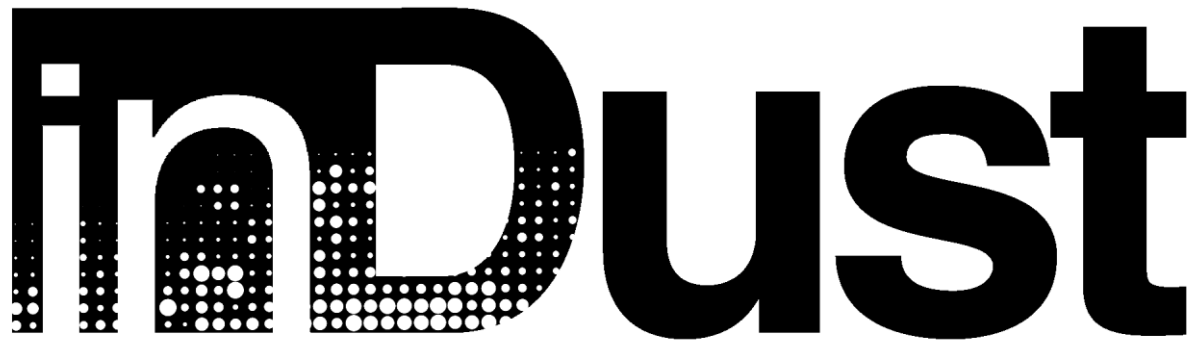
## How

- Identify scientific and technical **gaps in “dust” research**
- Coordinate and harmonise the process to get **user-oriented products**.
- **Build capacity** through the high-level teaching of users to promote the use of the delivered dust products.
- **Train staff** to properly use the available observational and forecast products to design and implement preparedness and mitigation measures.
- **Enhance the cooperation** with institutions from near-neighbouring and international partner countries in Northern Africa and the Middle East.

## How... Concept approach



Thanks for your attention!



*COST Action CA16202*

**Chair:** Dr Sara Basart (Spain)

**Vice-chair:** Dr Slobodan Nickovic (Serbia)

Period: 14 Nov 2017 – 14 Nov 2021

[www.cost-indust.eu](http://www.cost-indust.eu)

Contact: [cost-indust@bsc.es](mailto:cost-indust@bsc.es)